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Rheotherm flow meters are manufactured under United States patent numbers 4,255,968; 4,942,763; 4,949,578; 5,485,754, and 5,752,411
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TABLE OF CONTENTS

| | |
|---|--------|
| SECTION 1 - GENERAL INFORMATION | - 1 - |
| 1.1 INTRODUCTION | - 1 - |
| 1.2 DESCRIPTION OF OPERATION | - 2 - |
| 1.3 PRECAUTIONS | - 2 - |
| SECTION 2 - INSTALLATION | - 4 - |
| 2.1 TRANSDUCER | - 4 - |
| 2.2 ELECTRICAL CONNECTIONS | - 5 - |
| SECTION 3 - OPERATION | - 6 - |
| 3.1 START UP | - 6 - |
| 3.2 GENERAL INFORMATION | - 6 - |
| 3.3 ADJUSTING THE TRIP POINT | - 6 - |
| 3.4 USE AS A LEVEL SWITCH (INSERTION PROBES ONLY) | - 7 - |
| SECTION 4 - MAINTENANCE | - 8 - |
| 4.1 GENERAL MAINTENANCE | - 8 - |
| 4.2 SPARE PARTS | - 8 - |
| 4.3 TROUBLE SHOOTING | - 9 - |
| TABLE I. TROUBLE SHOOTING GUIDE | - 9 - |
| SECTION 5 - CUSTOMER SERVICE | - 10 - |
| 5.1 QUESTION ON EXISTING HARDWARE | - 10 - |
| 5.2 TROUBLE SHOOTING | - 10 - |
| 5.3 FACTORY AND FIELD SERVICE | - 10 - |
| 5.4 DECONTAMINATION OF EQUIPMENT | - 10 - |
| 5.5 QUESTIONS ON NEW EQUIPMENT | - 10 - |
| SECTION 6 - CUSTOM INFORMATION | - 11 - |
| 6.1 UNIT IDENTIFICATION | - 11 - |
| 6.2 CONFIGURATION | - 11 - |
| 6.3 SPECIAL INSTRUCTIONS | - 11 - |
| Figure 1. Model 100CS Interconnect Diagram | - 12 - |
| Figure 2. Model 100CS PWB Layout Diagram | - 12 - |

SECTION 1 - GENERAL INFORMATION

1.1 INTRODUCTION

Rheotherm flow switches offer reliable flow switch protection in liquids, gases and slurries. They can be used for flow/no flow detection, or specific low and/or high level alarms over a given 10 to 1 flow. They are manufactured exclusively by Intek, Inc. and employ a patented thermal technique used by industry since 1978. The unique transducer designs have protected sensors, are easy to install and require little or no maintenance.

Each model 100CS flow switch consists of an explosion-proof electronics enclosure mounted on a sensor head. The enclosure houses the round P/C board on which the relay and electrical interface connector are mounted. Intek also has other switch models where the sensor and electronics are separate units, for high temperature fluids or other conditions. In addition, a two relay flow switch is available for indicating high and low flow conditions.

Key features of Rheotherm flow switches are:

Nonintrusive flow monitoring For pipe sizes from .030 to $\frac{3}{4}$ inch, flow sensing is done from outside the flow tube.

No moving parts There are no rotating, translating, undulating or oscillating parts to wear, stick, break or fatigue.

Chemical compatibility The wetted surface(s) can be any of a number of corrosion resistant metals or alloys. There are no internal seals in a TU type transducer. Most sensors are 316 SS or 316 SS and nickel braze.

Fluid pressure options to several thousand psi.

Withstands over ranging No damage or change in operation will occur due to excessive flow rates many times higher than originally specified.

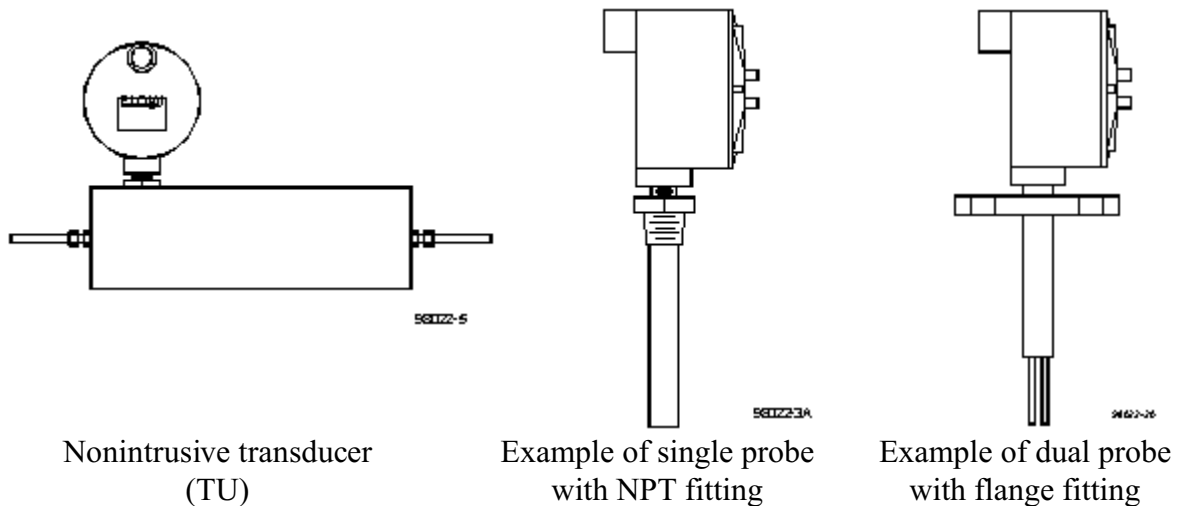
Immunity to shock and vibration.

Range of application includes flow monitoring in capillary tubes to large diameter pipes or ducts.

The model 100CS is the simplest Rheotherm flow instrument, meant for low temperature applications. Intek, Inc. also has flow switches (Model 100FS) for high temperature liquids and gases and other extraordinary process conditions.

1.2 DESCRIPTION OF OPERATION

Rheotherm flow switches are available with various nonintrusive and intrusive transducer designs, but they all use the same thermal sensing technique. Two temperature sensors are used — one is in thermal equilibrium with the fluid and provides a fluid temperature reference, while the second temperature sensor is located near a heater so that its temperature is slightly above that of the fluid. In a TU transducer, the temperature sensors and heater are attached to the outside of the flow tube, whereas the dual and single probe transducers have the sensors and heater located in the probe(s) that are inserted into the stream. The amount of heat removed from the heated sensor by the stream is related to fluid velocity. Hence, the measured temperature differential between the reference sensor and heated sensor is a function of flow rate. Only Intek, Inc. is licensed to use this patented and trademarked method for precision flow measurement.



1.3 PRECAUTIONS

1. Use proper input power — Check the label on the unit for the input power requirements.
2. Use reasonable care in handling the flow switch. Do not try to disassemble the transducers; there are no removable parts.

TU — excessive twisting or bending can damage the — sensor. The flow tubes are thin-walled tubing.

Probes (NPT/2I, NPT/I, BF/2I, BF/I, etc.) — take care not to bend the probes or — damage the tips. Do not try to remove or turn the electronics box.

3. Check the flow switch maximum temperature rating — do not operate a transducer at or subject it to a temperature above its specified limit.
4. Keep moisture out of the electronic enclosure. Once cable connections are made in the electronic box, make sure the lid is tightly closed. Seal conduit lines if they can become wet inside.
5. Keep transducer wetted surfaces clean and free of permanent layer build-up.

6. Do not exceed pressure limits of the tube or fittings.
7. Maintain a thermally stable environment (short-term) for the transducer and adjacent line. (See SECTION 2 INSTALLATION.)

These instructions cover installation, operation and maintenance of Rheotherm flow switches in standard configurations. Any special information pertaining to your unit is covered under CUSTOM INFORMATION (SECTION 6). Time should be taken to carefully read these instructions prior to installation of the equipment. Should any questions arise or problems occur, call Intek for immediate assistance.

SECTION 2 – INSTALLATION

2.1 TRANSDUCER

!! IMPORTANT: All transducers have a directional arrow on the tag and/or etched into a metal part. Before installing a sensor, please note proper flow direction. This is critical to sensor operation.

The transducer style supplied with your meter is listed in the model code number in SECTION 6. Proper installation of the sensor is necessary for achieving accuracy and repeatability. Installation suggestions for each type of standard transducer are given here. For custom transducer installations, refer to CUSTOM INFORMATION SECTION 6.

Be sure wetted surfaces are clean before installing. If cleaning is needed, use non-residue solvent and wipe dry. Keep moisture out of the electronics box. Make sure the lid is tightly sealed and, if supplied, the gasket is in place. Seal conduit lines at the electronics box if conduit lines can become wet.

1. TU Transducers

!! CAUTION: TU transducers are made with thin-walled tubing use care when installing. TU^{1/16} and TU^{1/8} transducers require particularly careful handling.

!! CAUTION: The electronics box should never be rotated for any reason.

Straight run for a flow switch is not a requirement, particularly for flow/no flow indications, but for best repeatability some straight run is useful, such as 10 to 20 pipe diameters on the inlet and 6 to 10 diameters on the outlet. If installed vertically, the flow should be going up through the sensor. Connection in the line is via compression fittings, hose with clamp, threaded fittings or flanges, whichever is appropriate. Care must be taken not to transmit a twisting force through the transducer's midsection. The TU transducer, whether flanged or not, must not be used to pull other piping together or to make up angular mismatch of fittings.

Typically, TU^{1/16}" O.D. flow tubes are sleeved with a 1/8" tube for added support. Fluid connections should always be made to the 1/16" tube, as there is no assured seal between the 1/16" tube and the sleeves.

Fluid temperatures other than ambient require special attention. Thermal gradients from one end of the transducer to the other, as well as along the radius of the connection pipe, are undesirable. Therefore, effective insulation should be installed around the inlet and outlet straight line runs. Gradients which may exist in the line further up stream can be removed if an insulated elbow is installed in the line prior to entering the straight line portion of the plumbing.

The ideal installation will provide the sensor with well established smooth flow, uniform system temperature and consistent fluid media.

2. Intrusive Probes

Straight run is not critical, but if trying to hold a precise set point, some straight run is useful, such as 10 to 20 pipe diameters on the inlet and at least 6 diameters on the outlet.

The various probe transducers are mounted through a threaded collar (NPT/2I and NPT/I) or flanged tee (BF/2I or BF/I). Other fittings and sensor designs are also available and are discussed on the Custom Information page. Generally the probes are sized so the tips extend $\frac{1}{2}$ to 1 inch beyond the pipe center line when properly installed. However, for larger pipes, the probes may extend in $\frac{1}{8}$ of a diameter from the wall.

Proper alignment of the sensor with flow is important; the flow direction is indicated on the transducer tag and/or etched into the transducer. All dual probe transducers (NPT/2I, BF/2I) are installed so that the two probes are side-by-side across the fluid stream. Never rotate the electronics box. If this occurs the flow switch could be damaged and/or installed misaligned with the flow direction.

For high temperature applications, the sensor and surrounding line should be well insulated. Leave a portion of the transducer neck un-insulated to allow heat dissipation before reaching the junction box.

2.2 ELECTRICAL CONNECTIONS (See Figure 1 on page 12)

The input power requirement is listed on the tag on the electronics enclosure; make sure the input power source is compatible. The standard power requirement is 120 Vac, 60 Hz, single phase (220 Vac, 50 Hz and 24 Vdc are options).

Wire sizes no smaller than 24 gauge can be used for power. The electronics power ground is common to the transducer casing. 14 gauge stranded wire is recommended for the relay contacts (10A resistive at 120 Vac, 5 Amps resistive at 240 Vac).

The input power and relay connections are made as shown in Figure 1. Note the connector is removable for easier insertion of the wires. Once all connections are made, firmly push the connector back onto its base. Be sure the wires are stress relieved sufficiently to prevent an inadvertent disconnect.

The typical housing for a 100CS flow switch is a round explosion-proof enclosure. When ready for use, the housing lid should be tightly screwed on. A gasket is included when rain tightness is required. Here again, the lid should be on tight to make a good seal against the gasket.

SECTION 3 – OPERATION

3.1 START UP

Typically, Rheotherm flow switches come from the factory set up for a 10 to 1 flow rate range, and with the trip level set approximately as requested by the customer. The trip level can be adjusted using the instructions in SECTION 3.3.

When power is first turned on, the flow switch may indicate a high flow rate, even if there is no flow occurring. Correct indication of flow level will result after an initial period, which can extend to about forty (40) seconds and depends on where the trip adjust is set.

For standard flow switches, the relay operates as stated below. For nonstandard units, the operation is described in SPECIAL INSTRUCTIONS (SECTION 6).

- A. Low Flow Switch The relay is energized (N.O. contact is closed) and the LED is *green* when the flow rate is **above** the trip level. Therefore, the alarm condition (relay de-energizes) occurs when the flow rate drops below the trip level or there is a loss of power to the sensor (N.O. contact is *open* and LED color becomes *red*).

- B. High Flow Switch The relay operation is exactly as described above. When used as a high flow switch, the alarm condition is considered to be when the relay is energized (N.O. contact is *closed* and LED color becomes *green*).

3.2 GENERAL INFORMATION

The Rheotherm instrument is compensated for a wide range of both ambient and flowing media temperatures. However, abrupt changes in the temperature of the flowing material can cause the instrument to read the flow rate improperly, which could lead to an inappropriate tripping of the relay or a delay in reading loss of flow. A proper reading is obtained only when the transducer is in thermal equilibrium with the material. Typically, a 20°F abrupt change in temperature may require 40 seconds to stabilize.

In general, the heater used in the transducer does not develop enough power to cause damage to the system in the absence of flow. This includes those used in liquids even if the line becomes empty and filled with air. Special cases will be discussed in the section entitled SPECIAL INSTRUCTIONS (SECTION 6).

3.3 ADJUSTING THE TRIP POINT

Adjust the flow switch trip point as follows (see Figure 2, page 12, for trip potentiometer location):

1. Establish a flow rate at the desired trip level. (This should be done with flow in the line, not at zero flow. Select a flow rate below your normal usage. One example would be to use 50% of your lowest normal flow rate as the set point.)
2. If the LED is *green*, adjust "Trip" potentiometer clockwise until the relay de-energizes (LED turns *red*). This is the alarm condition.
3. If LED is *red*, adjust "Trip" potentiometer slowly counterclockwise just until the relay energizes (LED turns *green*).
4. If the relay cannot be made to drop out over the full range of the "Trip" potentiometer, see TABLE I.

3.4 USE AS A LEVEL SWITCH (Insertion Probes Only)

The probe switch design can be used to provide one point level switch indication. When the probe tips are submerged in liquid, the relay is energized and the LED is green. When the liquid level drops below the probes and they are surrounded by air or vapor, the relay de-energizes and the LED turns red.

SECTION 4 - MAINTENANCE

4.1 GENERAL MAINTENANCE

Certain precautions should be taken to insure proper performance of all models of flow instruments. Since the measurement technique involves a signal resulting from heat transfer to the flowing medium, care should be exercised to prevent build-up of varying layers on the walls of the transducer. Layers such as bacterial growth, dried paints, gas bubbles and non-solubles can result in measurement below actual flow rates. Periodic checks and cleaning should be performed to insure a clean pipe or probe surface.

It should be part of normal maintenance procedure to check the system for proper functioning. Experience and other observable conditions should be utilized to determine the frequency of inspection. To test the flow switch action, the flow rate should be reduced below (for low flow switch) or raised above (for high flow switch) the switching level. Then check and insure relay action and continuity of the shut down or warning circuits which it operates.

The joints of all intrusive probes tips should be inspected for wear and corrosion.

4.2 SPARE PARTS

There are no normally recommended spare parts to stock. Should a spare be needed, a complete unit should be ordered and stocked.

If fuse replacement is ever needed, for AC powered units, use a Wickman part no. 3730500041 ($\frac{1}{2}$ A, fast acting fuse) or equivalent. For units powered by 24 Vdc, the fuse is a 1A, slow blow fuse and may be replaced with Wickman part no. 3741100041 or equivalent.

4.3 TROUBLE SHOOTING

TABLE I. TROUBLE SHOOTING GUIDE

| OBSERVATION | PROBABLE CAUSE | REMEDY |
|---|---|---|
| Flow trip level continually drifting downward with constant flow. | Coating forming on wetted surface of transducer. | <ol style="list-style-type: none"> 1. Clean transducer periodically. 2. Adjust trip potentiometer clockwise until layer build-up stabilizes. |
| After switch has been operating properly: Relay trips with flow above trip level and cannot be adjusted using SECTION 3.3 instructions. Relay does not trip when flow falls below trip level and cannot be adjusted using SECTION 3.3 instructions. | Bad electronic component. | Contact factory. |
| Relay cannot be made to trip by adjusting "Trip" potentiometer. | <ol style="list-style-type: none"> 1. Initial flow rate estimate was too low or too high. 2. Flow media change. | <ol style="list-style-type: none"> 1. Check flow conditions. 2. Contact factory. |
| LED is not lit and relay stays in alarm condition (N.C. contact is made). | <ol style="list-style-type: none"> 1. No power to electronics. 2. Blown fuse. | <ol style="list-style-type: none"> 1. Check incoming power. 2. Replace fuse with ½ Amp fast acting fuse (fuse is in PCB socket). 3. Contact factory. |

!! CAUTION: The electronics are not protected against condensed liquid water inside the enclosure. If conduit is used, be sure conduit is dry or sealed at the instrument to prevent conduit condensation from entering the enclosure.

SECTION 5 – CUSTOMER SERVICE

Intek's corporate philosophy is to solve our customer's difficult flow measurement problems. This means that each instrument is custom configured and calibrated for the application. When you purchase a Rheotherm instrument you also receive Intek's outstanding customer service. For sales or product service, call your local representative or Intek directly at (614) 895-0301, 8AM to 5PM EST/EDT weekdays or fax us anytime at (614) 895-0319. E-mail inquiries should be sent to sales@Intekflow.com or techsupport@Intekflow.com. Our customer service staff will provide assistance promptly.

5.1 QUESTION ON EXISTING HARDWARE

To allow us to help you more quickly, please have the serial number of the equipment available before you call.

5.2 TROUBLE SHOOTING

If you have reviewed SECTION 4.4 TROUBLE SHOOTING and have questions, please call our experienced engineers for assistance. In many cases we can solve a problem over the phone. Please provide as complete a description as possible of the problems encountered.

5.3 FACTORY AND FIELD SERVICE

If you request field service, Intek has experienced engineers available to meet your needs. Many of the repairs or recalibrations will require returning the instrument to the factory. If a problem cannot be solved over the phone, with your help, we will determine if factory service or field service will be the best solution.

To request factory service, a Return Material Authorization (RMA) and purchase order is required. Our customer service staff will assist you with the required information to return instruments for service.

5.4 DECONTAMINATION OF EQUIPMENT

For the safety of your personnel and ours, any hardware that has been in contact with potentially hazardous liquids or gases must be properly decontaminated before shipment to Intek.

5.5 QUESTIONS ON NEW EQUIPMENT

For a new Rheotherm application or any liquid or gas flow measurement need, contact your local Rheotherm representative or the Intek technical sales department at the above phone/fax numbers. Our staff will be pleased to answer all questions and provide quotations.

SECTION 6 - CUSTOM INFORMATION

6.1 UNIT IDENTIFICATION

Model no.: _____

Serial no.: _____

Customer identification: _____

6.2 CONFIGURATION

The configuration of this unit, as originally shipped from the factory:

Input Power:

115 Vac, 50/60 Hz 230 Vac, 50/60 Hz 24 Vdc _____

Line Connection:

6.3 SPECIAL INSTRUCTIONS

| | Reference | | Reference |
|---|-----------|--------------------|-----------|
| _____ None | _____ | _____ Installation | _____ |
| _____ Other | _____ | | |
| _____ Trip level adjustment required for start up | _____ | | |